GRASSROOTS JOURNALS

Grassroots Journal of Natural Resources, Vol.6 No.3 (December 2023)
ISSN: 2581-6853 | CODEN: GJNRA9 | Published by The Grassroots Institute
Website: https://grassrootsjournals.org/gjnr | Main Indexing: Web of Science

ISSN 2581-6853 | 6(2) Dec 2023

M – 00362 | Review Article

Reviewing the Impact of Military Activities on Marine Biodiversity and Conservation: A Study of the Ukraine-Russia Conflict within the Framework of International Law

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How to cite this paper: Tahmid, A., Khanam, S., Rashid, M.M. and Ibnat, F. (2023). Reviewing the Impact of Military Activities on Marine Biodiversity and Conservation: A Study of the Ukraine-Russia Conflict within the Framework of International Law. *Grassroots Journal of Natural Resources*, 6(3): 15-31. Doi: https://doi.org/10.33002/nr2581.6853.060302

Received: 22 August 2023
Reviewed: 18 October 2023
Provisionally Accepted: 30 October 2023
Revised: 15 November 2023
Finally Accepted: 27 November 2023
Published: 31 December 2023

Abstract

The severe consequences of military activities on marine biodiversity and conservation have come to limelight as a result of the Ukraine-Russian conflicts in the Black Sea region. The battle has had both immediate and collateral environmental effects on the Black Sea, a hotspot for numerous and uncommon aquatic species. Oil spills, the discharge of toxic substances, and habitat deterioration are only a few of the direct effects that have harmed marine environments and destroyed crucial breeding sites. The fragile balance of the marine life in the area is further threatened by indirect effects caused by fishing practices, increased marine traffic, and advances in coastal infrastructure brought on by conflicts. This ongoing conflict has infringed upon international agreements, including the Basel, Stockholm, and London Conventions, through military activities in the Black Sea, resulting in the violation of regulations governing hazardous waste movement and posing a threat to the biodiversity of the region. This review discusses the breaches and analyzes the harms caused in the marine ecosystem and resources and proposes suggestions as to combine military tactics with conservation and restoration activities.

Keywords

Marine resources; Black Sea region; Marine environment; Military operations; Sustainable methods

Introduction

The Ukraine-Russia conflict has had far-reaching environmental consequences, particularly for the Black Sea region's marine ecosystems. A wide range of land and sea-based military activities are endangering Ukraine's marine ecosystems, while the fighting has directly impacted fragile and environmentally vulnerable coastal habitats (CEOBS, 2023). This protracted conflict has entailed a variety of military activities that have resulted in

substantial ecological disruptions, threatening the fragile balance of the marine ecosystem. The situation in the Black Sea Region is exceedingly complicated due to Ukraine's severe crisis, the ongoing fires in Donbass, Russia's role in the "frozen conflicts," and the region's increasing militarization. Russia has frequently utilized armed forces outside its boundaries to exert foreign policy pressure (Bekiarova, 2017).

When discussing the environmental effects of the war, most of the people focus on terrestrial repercussions. On the contrary, war has no less influence on the sea, and the marine biodiversity is more sensitive to military impacts than land-based ecosystems, owing to the interconnectedness of water bodies (Kolodezhna and Vasyliuk, 2022). In the ongoing conflict between Russia and Ukraine, the Russian military's launch of cruise missiles through the Black Sea directed to Lviv in Ukraine has had a devastating environmental impact, leading to ecological disasters on the surrounding areas since constant missile testing in the sea impedes marine wildlife (Olajide, 2022). Active marine hostilities and Russian warships currently stationed in the Black Sea's northwestern region not only block Ukraine's seaports, putting the world at risk of global famine, but also create man-made disasters that severely affect the Black and Azov Seas' coastal and marine ecosystems (UWEC Work Group, 2023). The Azov-Black Sea coast of southern Ukraine is a kaleidoscope of distinct coastal and marine environments, including estuaries, lagoons, islands, salt marshes, and sea grass meadows, and is home to hundreds of uncommon species.

In the Black Sea region, the battle also alters migratory patterns and species composition. Military activity such as under-sea explosions, naval operations, and barrier construction can drastically affect marine species' migration paths and behaviour. For their feeding, reproducing, and survival, the fish, marine animals, and sea turtles rely on specialised ecosystems and migration patterns. Any interruption to these patterns can have a negative impact on their populations, potentially resulting in decreased biodiversity and uneven ecological dynamics. Hostilities have an impact on underwater marine environments as well. Sunken ships and missiles, anchor usage, and ammunition blasts can all harm underwater habitats. Chemical and acoustic pollution, physical damage to habitats, and a reduction in conservation activities are the principal effects of the armed conflict on coastal and marine ecosystems (CEOBS, 2023). The article seeks to provide a complete account of the conflict's ecological repercussions and legal difficulties, as well as it investigates international laws and treaties pertaining to marine conservation, as well as their applicability in conflict zones. The article goes on to examine how military activities during the conflict have broken or challenged existing international environmental laws.

This article is based on a review that used a narrative review approach, which is a traditional method for qualitatively analyzing the existing material. This method entailed selecting relevant research literature while accepting its limitations. The information in the narrative review was arranged in a logical manner to provide a clear and coherent comprehension of the issue. In conclusion, this review work used a systematic technique to analyze the environmental consequences of Russia's war in Ukraine. Formulating research questions, conducting literature searches, screening sources, reviewing the findings, extracting data, and performing qualitative analysis were all part of the process. The narrative review structure was utilized to convey the

synthesis knowledge in a logical order, allowing for a thorough examination of the subject. Before the review began, the following research questions were formulated:

1. How has the Ukraine-Russia conflict affected the Black Sea region's marine ecosystems, and what are the unique environmental effects of this lengthy war?
2. To what extent has military activity in the Black Sea region, including armed engagements and naval operations, had an impact on the environment and violated international law?

Description of the Black Sea Region

The Black Sea is a virtually enclosed and zonally extended basin with a zonal dimension of around 1,200 km and meridional dimensions ranging from 500 km on the western side to 250 km on the eastern side. With a surface area of 423,000 km^2, it is roughly one-fifth the size of the Mediterranean. Through the Turkish Straits System, it has limited connection with the Aegean Sea. The Black Sea receives freshwater inflows from all across the basin, but the major ones (the Danube, the Dniestr, and the Dniestr) discharge into the basin's northwestern coastal waters (UN Environment, 2017). The Black Sea, which is connected to the Mediterranean Sea through Istanbul, Canakkale (Turk Straits), and Gibraltar straits and to the Sea of Azov in the northeast through the Kerch Strait, is the ocean that is the remotest from the rest of the world. Its surface area to catchment area ratio is more than 6. This makes the Black Sea extremely susceptible to pressure from land-based human activities, and both the coastal and non-coastal conditions of its basin have an equal impact on the health of the Black Sea.

The Black Sea region, which is comprised of the landmass and waters from the Balkans to the Caucasus and from the steppes of Ukraine and Russia to Anatolia, is once more directly in the focus of European policymakers. NATO and the European Union (EU) now share a western border with the Black Sea. Its southern border is shared with NATO member and EU candidate Turkey. On its north and east sides, it is surrounded by Council of Europe members and two potential NATO members (Borou, 2009).

The Black Sea has a surface area of 4:2105 km2 and maximum and average depths of 2200 and 1240 meters, respectively. Anoxic water makes up 90% of its total mass. Thus, it contains the world’s largest anoxic water mass (Bakan and Büyükgüngör, 2000). The Black Sea is a one-of-a-kind maritime ecosystem with exceptional biodiversity and ecological significance. Its various habitats, which include coastal areas, shallow shelves, and deep basins, sustain a rich diversity of animals. The sea is home to nearly 2,000 plant and animal species, including many rare and endangered species. The Black Sea's diverse biodiversity adds to its ecological resilience and stability. It is essential for the general health and balance of the region's ecosystems. Furthermore, the Black Sea serves as a major breeding and feeding habitat for many migratory species, including dolphins, whales, and seabirds. The conservation and preservation of the Black Sea's biodiversity is critical not only for the long-term viability of its ecosystems, but also for the overall well-being of the neighboring countries and the globe.

Figure 1: Location of the Study Area (Adapted from Cherkez, Dragomyretska and Gorokhovich, 2006)

Military Activities surrounding Ukraine-Russia War

The Ukraine-Russia conflict has seen major military activity on both sides, with far-reaching consequences for the area. Ukrainian military have been engaged in defensive operations to maintain their territorial integrity and sovereignty since the beginning of the conflict. These actions have included increasing border security, mounting counteroffensives, and reinforcing critical strategic sites. In response, Russia has committed significant military assets, including infantry personnel, artillery, and air power, to back their rebel proxies in eastern Ukraine. This has resulted in heavy conflict marked by artillery shelling, tank fights, and aerial bombardment. The military activities in the Ukraine-Russia war have had terrible consequences, resulting in the loss of life, the displacement of civilians, and severe damage to infrastructure. The situation remains dangerous, and efforts to find a peaceful settlement to the conflict continue.

A wide range of land and sea-based military activities have endangered Ukraine's marine ecosystems, while the fighting has directly impacted fragile and environmentally vulnerable coastal habitats (CEOBS, 2023). Coastal wetland ecosystems cover broad areas and connect the vast catchment area to the Black Sea. Wetlands are extremely productive ecosystems and have traits that are determined by the water regime. Because of the steady inflow of water and alternating dry and wet times, they maintain a unique diversity of flora and fauna. The most common types of wetlands in the Black Sea region include lagoons, estuaries, and deltas.

Water is a basic and precious resource for all life on Earth. As a result, it plays a critical role in achieving the Sustainable Development Goals by ensuring societal and environmental well-being (UN-Water Technical Advisory Unit, 2016). At the same time, during violent conflicts, freshwater as a resource (Francis, 2011) and related

water infrastructure (Mason, 2022) are among the most vulnerable sectors. This has heightened interest in the function of water as a source of conflict (Gleick, 2019) as well as the consequences of armed wars on water and water systems (Schillinger *et al.*, 2020; Khilchevskyi and Mezentsev, 2021).

Chemical and acoustic pollution, physical damage to habitats, and a reduction in conservation activities are the principal effects of the armed conflict on coastal and marine ecosystems. Environmental monitoring and control of the Black and Azov seas have also been hampered by the fighting. Chemical contamination in the coastal and marine environment can be caused by damaged industry and settlements. Ecodozor data show that reported damage and disruption to coastal villages has increased as the conflict has progressed, whereas recorded events affecting heavy industry in coastal locales have decreased over the same time period.

Timeline of the Conflict

Since its commencement, the conflict between Ukraine and Russia has gone through several stages. The dispute may be traced back to February 2014 when Russia annexed Crimea, causing tensions between the two countries. Pro-Russian rebels in eastern Ukraine declared independence in April 2014, sparking fighting with Ukrainian soldiers. Contending intensified in 2014 and 2015, with both sides contending for control of key cities such as Donetsk and Luhansk. The Minsk Protocol, a ceasefire deal agreed in February 2015, was repeatedly broken, resulting in the restart of hostilities. The battle raged on, with sporadic clashes and occasional escalation. A prisoner swap and disengagement deal was signed in 2019, indicating some movement toward a peaceful resolution. However, tensions persisted and ceasefire violations continued. When Russia launched a large-scale invasion of Ukraine in 2022, the conflict entered a new phase, resulting in a significant escalation of hostilities. The timeline of the conflict emphasizes the conflict's multifaceted and lengthy nature, with occasional periods of relative peace followed by periods of high violence and instability.

The military confrontation between Ukraine and Russia, as defined by the International Committee of the Red Cross (ICRC, 2008) which began on February 24, 2022, is a remarkable case in terms of its environmental impact (Pereira *et al.*, 2022; Zheleznyak *et al.*, 2022; Rawtani *et al.*, 2022). The effects of Russia's military actions on coastal ecosystems are already visible in several nature reserves on the Crimean Peninsula, which has been occupied since 2014. The state of Opuk Nature Reserve, which has practically been transformed into a military training area, is particularly revealing. During Russian military drills, bombing, military equipment movements, the detonation of sonic bombs in the water, and troop landings have all affected local coastal, steppe, and estuary environments (UWEC Work Group, 2023).

Types of Military Activities

The Russia-Ukraine conflict, which erupted in 2014, has resulted in at least two gray zones: the Black Sea and Eastern Ukraine. The gray zone in the Black Sea included the coastal seas of illegally occupied Crimea and its respective exclusive economic zone (EEZ) (Kormych and Malyarenko, 2022). Initially, the term 'gray zone' was

applied to a specific kind of maritime conflicts; specifically, methods originating from territorial disputes in the Asia-Pacific area in the late 2000s under challenge from coastal States (Holmes and Yoshihara, 2017). Various forms of military activities have been observed in the Ukraine-Russia war, reflecting the conflict's multifaceted nature. Military equipment movements and fortress construction not only cause physical destruction of soil and plants, but they can also endanger coastal marine habitats. Biotopes in the swash and surf zones, which include unique biodiversity among the sand and shells, may also be harmed as a result of coastal minelaying, explosions, and sand mining from beaches for use in fortifications. Conventional warfare is a common sort of military activity that involves the use of conventional weaponry such as tanks, artillery, and infantry in direct combat operations. Several attacks by Ukrainian armed TB2 drones caused damage, but many of these valued weapons were also shot down. The Russian forces on the islet, which are well armed, are becoming capable of repelling attacks. Battles over control of significant areas, cities, and strategic places are included. Another important factor is asymmetric warfare, in which pro-Russian separatist groups, backed by Russia, have used guerrilla tactics such as ambushes, hit-and-run attacks, and insurgency operations. Aerial operations have also played an important role, with both sides carrying out airstrikes, deploying combat helicopters, and engaging in air-to-air combat. The planned introduction of offensive systems such as long-range artillery and S-400 air defence units would allow Russia to dominate the airspace over Ukraine's south as well as the Black Sea's northwestern region.

Scale and Intensity of Operations

The scale and intensity of military actions in the Ukraine-Russia war have been enormous, with far-reaching regional implications. Ukraine and Russia have both deployed major military assets, including as troops, armored vehicles, artillery, and aircraft, demonstrating the gravity of the confrontation. These operations have spanned multiple fronts, particularly in eastern Ukraine, where fierce clashes for crucial territory have raged. The presence of international entities adds to the scope of the conflict, with Western countries supporting Ukraine and Russia supporting separatist troops. The deployment of heavy armament, such as missiles, bombs, and rockets, reflects the intensity of military operations, resulting in widespread destruction, casualties, and civilian displacement. The conflict has also seen significant urban combat, with cities and towns turning into battlegrounds, resulting in massive collateral damage. The magnitude and intensity of military operations in the Ukraine-Russia conflict emphasize the gravity of the situation and the critical necessity for diplomatic measures to bring about a peaceful end and alleviate the humanitarian disaster. Although current military technology allows for the precise destruction of targeted items, environmental damage to industrial targets is not usually local, and many of the attacks have been widespread rather than precise. In highly industrialized Ukraine (Lishchynskyy, 2016) concentrating on urban and industrial infrastructure there are unavoidably wide-ranging and severe environmental implications (Shumilova *et al.*, 2016)

Port infrastructures along the Black Sea and Azov Sea coasts at Mykolayiv, Odessa, and Mariupol were brutally bombed. Other implications on water resources, such as the damage to regional biodiversity, can only be estimated at this time. It has been stated that 14 Ramsar wetland habitats encompassing 400,000 hectares along the

Dnieper River's lower reaches are under threat (Cundy, 2022). . Catchments traverse political boundaries, and toxins released into the environment as a result of violent wars can spread beyond borders. Ninety-eight percent of Ukrainian river catchment area flows to the Black Sea and Azov Sea, with the remaining 2% flowing to the Baltic Sea. Fire also affected the territories of many protected sites. Since the beginning of 2022, the total surface area of fires in Ukrainian forests has climbed a hundredfold (compared to the same period the previous year). Many reserves in Mykolaiv and Kherson regions have been impacted by these fires, including Biloberezhya Svyatoslava National Nature Park, Kinburn Split Regional Park, Black Sea Biosphere Reserve, and Lower Dnipro National Nature Park. Kinburn Spit Park, located on the Black Sea coast and home to rare coastal habitats, burned down in May 2022 (UNEC Work Group, 2023b).

Environmental Impact and Violations of International Laws

The prolonged conflict between Ukraine and Russia has wreaked havoc on the ecology in the impacted areas. The destruction of essential infrastructure, such as power plants and factories, has resulted in the discharge of toxic substances and pollutants into the environment, endangering ecosystems and endangering human health. The current Russia-Ukraine conflict is Europe's most visible conflict since World War II, with geopolitical, economic, infrastructure, and health repercussions (Rawtani *et al*., 2022). Water resources, such as rivers and groundwater, have been contaminated as a result of damage to water treatment facilities and industrial sites (WWF, 2023). Furthermore, the violence has resulted in the destruction and fragmentation of natural areas, negatively harming biodiversity and ecosystems. The displacements of communities, as well as the existence of landmines and explosive munitions, increase the region's environmental difficulties. Environmental assessments and mitigation efforts have been hampered by ongoing hostilities and limited access to affected areas.

Hostilities have an impact on underwater marine environments as well. Sunken ships and missiles, anchor usage, and ammunition blasts can all harm underwater habitat. Because benthic sea grass or algal populations have the highest biological variety, damage to them may be a deciding factor for the entire ecosystem. While the remnants of wrecked ships can be used to build new habitats on artificial "reefs" colonized by aquatic creatures, the damage caused by long-term pollution outweighs any possible benefits (UWEC Work Group, 2023b)

The current Russia-Ukraine conflict has had serious political, economic, and environmental consequences. As previously stated, the destruction of critical infrastructure, such as power plants and factories resulting in the discharge of toxic substances and pollutants into the environment, and also endangering of ecosystems and endangering of human health clearly contradicts the ideals outlined in the Stockholm Declaration of 1972[1] and the World Charter for Nature[2]. Although war is not specifically mentioned in the Stockholm Declaration of the United Nations Conference on the Human Environment from 1972, it does have consequences for

[1] https://wedocs.unep.org/bitstream/handle/20.500.11822/29567/ELGP1StockD.pdf
[2] https://digitallibrary.un.org/record/39295?ln=en

how the environment is protected during hostilities. Reiterating a fundamental rule of international law, Principle 21[3] demands that countries refrain from endangering the environments of other countries. This rule applies in both peace and war.

States are required by Principle 7[4] to take all reasonable measures to prevent marine pollution from pollutants that endanger human health, living resources, marine life, and other legal uses of the sea. This Principle emphasizes a dedication to safeguard the marine environment in both peace and conflict. In addition, Principle 22[5] requires nations to create cooperative procedures to compensate those harmed by activities within one state that have an impact on places outside of it. This includes harm to the ocean ecosystem brought on by armed warfare. Principle 24[6] promotes international collaboration to prevent, reduce, and eliminate negative environmental effects caused by international circumstances, especially those brought on by armed conflict. The protection of the environment, including the marine environment, from the effects of weapons of mass destruction, including nuclear weapons, is a last tenet of Principle 26[7].

The Stockholm Declaration offers a strong framework of Principles that may direct States in conserving the marine environment throughout both peace and conflict, although without expressly mentioning fighting. The Russia-Ukraine conflict, with its vast environmental destruction and degradation, exemplifies the critical necessity for international collaboration and commitment to the ideals outlined in global environmental treaties. The long-term ecological consequences of battle, particularly in biologically diverse and sensitive regions like as Ukraine and Russia, highlight the necessity of global mechanisms such as the Stockholm Declaration and the World Charter for Nature.

The Ukraine-Russia conflict also serves as a reminder that the Principles enshrined in the Hague Conventions[8], though over a century old, still bear relevance today. Their spirit, rooted in harm minimization, transcends direct human impacts. During the Russia-Ukraine conflict, Russian anti-ship missiles twice targeted an abandoned cargo tanker in the northern Black Sea, which had around 600 tons of diesel gasoline. The tanker, which was carrying thousands of barrels of fuel, was dubbed a "environmental time bomb" by Interfax-Ukraine News, stressing the possibility of oil spills during the fight (Lieber Institute, 2022). The Hague Conventions of 1899 and 1907 are regarded as seminal works of international law, laying the groundwork for the conduct of combat. While these accords did not specifically address maritime environmental protection, the spirit of their principles reflects a broader commitment: limiting harm during conflicts. Recent events in the Ukraine-Russia conflict highlight the importance of revisiting these concepts in light of marine environmental concerns. Article 22[9] of the Regulations Annexed to the Hague Convention of 1907 states “belligerents' ability to use weapons against their adversaries is limited.

[3] https://legal.un.org/avl/ha/dunche/dunche.html
[4] https://legal.un.org/avl/ha/dunche/dunche.html
[5] https://legal.un.org/avl/ha/dunche/dunche.html
[6] https://legal.un.org/avl/ha/dunche/dunche.html
[7] https://legal.un.org/avl/ha/dunche/dunche.html
[8] https://guide-humanitarian-law.org/content/article/3/the-hague-conventions-of-1899-and-1907/
[9] https://www.britannica.com/topic/law-of-war/Limits-on-the-methods-and-means-of-war

The Convention's guiding principle of minimizing unnecessary suffering and destruction is supported by the long-term impacts of oil spills on marine biodiversity and the deterioration of water quality. Despite the agreements' main emphasis on human suffering, one may argue that severe ecological harm indirectly impacts human groups that depend on natural ecosystems. Article 23(g) of the 1907 Hague Convention IV embodies the idea of military necessity (Bouvier, 1992) by stating that one should not damage or capture the enemy's assets unless absolutely necessary for war reasons. This provision has significant environmental consequences because "enemy assets" can include protected areas, environmental and natural resources, providing them with implicit protection.

Oil spills in the Black Sea as a result of the Russia-Ukraine conflict may violate UNCLOS's[10] protective principles, indicating a breach of international duties toward marine conservation. The United Nations Convention on the Law of the Sea (UNCLOS) is a key global convention that addresses marine pollution. Section XII, in particular, emphasizes "Protection and Preservation of the Marine Environment," with Article 194 requiring governments to prevent and decrease marine pollution and to coordinate their efforts in this regard. Dolphins were one of the Black Sea biota dwellers affected by its impact (Renolafitri and Yolandika, 2022). The Turkish Marine Research Foundation stated in February 2022 that the figure of 80 dolphin deaths was based on reports of complaints for mammals stuck on the beach since late February(Istanbul, 2022) According to local media, the majority of dolphins were discovered dead, leading Turkish Marine Research Foundation specialists to infer that dolphin deaths were caused by disrupted echolocation caused by polluted environments (Renolafitri and Yolandika, 2022). According to sources, almost 3,000 dolphins were discovered dead with marks from water mines or bombs (Andreikovets, 2022).

This terrible occurrence is linked to violations of the principles outlined in the Convention on Biological Diversity[11] (CBD). The CBD, which was established at the Earth Summit in 1992 and is supported by 157 countries, serves as a bulwark against actions that cause severe biodiversity loss, especially those arising from warfare. The agreement emphasizes the need of protecting our planet's rich biological fabric and encouraging international cooperation in utilizing these resources for humanity's benefit while ensuring their preservation. In a preface to a book (Holdgate and Giovannini, 1994) co-published by the International Union for Conservation of Nature (IUCN) and the International Academy of the Environment in Geneva, the Biodiversity Convention is referred to as:

> "[…] simply an enabling document and treaty. It sets out what governments have agreed on regarding mutual support to national efforts to conserve the wealth of the planet, and collaboration to enable biological resources to be developed and used to the maximum possible benefit of people (Holdgate and Giovannini, 1994). Notably, the CBD is more than just a symbol. It explicitly specifies specific responsibilities for states. Article 3 specifically states that governments are responsible for ensuring that their military activities, both within their boundaries and in regions under their control, do not cause environmental harm, either locally or internationally. The heinous episodes in

[10] The United Nations Convention on the Law of the Sea, https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf
[11] https://www.cbd.int/

> the Black Sea, as indicated by extensive dolphin deaths attributed to conflict-related activity, might be considered as a substantial violation of the CBD's ethos and instructions. The CBD's basic purpose — to prevent a significant reduction or loss of biodiversity — appears to have been undermined in this case, underscoring the importance of adhering to international conventions even during times of conflict."

The Basel Convention[12], ratified by 116 UN member States in 1989, demonstrates the international community's commitment to regulating cross-border hazardous waste flows and ensuring environmentally safe disposal. Within its folds is defined the term "Environmentally Sound Management," which is defined in Article 2(8) as the comprehensive steps required guaranteeing hazardous wastes are managed in order to protect both human health and the environment. The Convention indirectly fortifies maritime environments against negligent waste disposal at sea by encouraging appropriate garbage movement. However, as the current conflict in Ukraine unfolds, evidence reveals possible violations of the same principles outlined in the Basel Convention. The violent conflicts have shattered vital infrastructure, with several Ukrainian communities experiencing disruptions in wastewater treatment, resulting in considerable water pollution. Untreated wastewater poured into the Kakhovka Reservoir due to the shutdown of the treatment facility near Zaporizhzhia runs counter to the Convention's objectives.

Multiple Ukrainian communities have been left without wastewater treatment as a result of the armed conflict, resulting in surface water pollution. Remote sensing pictures, for example, revealed that filthy wastewater was dumped into the Kakhovka Reservoir when the wastewater treatment plant near Zaporizhzhia discontinued operations (Shevchuk, Vyshnevskyi and Bilous, 2022). The United Nations estimated that by 20 April 2022, 6 million people in Ukraine were battling every day to get access to drinking water, with 1.4 million people reported to lack access to safe water in the country's east and another 4.6 million having only limited access (UNICEF, 2022). For the first time, traces of oil products were detected in the area of the surface drinking water intake in the basin of the Siverkyi Donets River in June-July 2022, along with elevated concentrations of mercury, ammonium nitrogen, nitrites, polyaromatic carbons, heavy metals, and the insecticide cypermethrin in some rivers within the basin (State Agency of Water Resources of Ukraine, 2022). The dumping of polluted wastewater into the Kakhovka Reservoir, as well as the alarming contamination of water sources with oil products and other hazardous pollutants, not only endangers human health and livelihood, but can also be viewed as a violation of the Basel Convention's principles. Despite the fact that the Convention focuses primarily on waste transboundary mobility, the spirit of the document stresses the protection of the environment and human health from the hazards of hazardous waste. The enormous environmental deterioration in Ukraine during the armed conflict emphasizes the importance of adhering to and executing international environmental standards and conventions, particularly the Basel Convention, even during wartime. Ninety-eight percent of Ukrainian river catchment area flows to the Black Sea and Azov Sea, with the remaining 2% flowing to the Baltic Sea. Despite the fact that the international community has clearly acknowledged the risk of environmental

[12] https://www.basel.int/

degradation in the Donbass region of eastern Ukraine since 2014 (Hook and Marcantonio, 2022), the seaports of Ochakiv and Mykolaiv were frequently attacked. The Dniester Estuary Bridge was shelled five times and entirely destroyed, and intense fights were conducted on the land of the Azovstal facility in Mariupol, which is located immediately on the Azov coastline (UWEC Work Group, 2023a). Nobody knows how many mines were dropped, broken off, or carried into the Black Sea as a result of the battle. The extent of the damage to the marine ecosystem and species caused by the detonation of mines discovered in Turkey and Romania remains unknown.

Razom, a non-profit Ukrainian-American human rights group that works to help Ukraine and raises the voices of Ukrainians, says, "The destruction of vital infrastructure along the Azov-Black Sea coast, such as oil depots and sewage treatment plants, can have devastating consequences, including oil spills and the release of toxic waste into the sea," explaining that this endangers marine life and the protected species that live there (Fowler, 2023). Water infrastructures, such as sewage treatment plants, as well as some facilities storing hazardous items such as solvents, ammonia, and plastics, have been severely damaged, according to the UN Environment Programme (UNEP) (Fowler, 2023). According to the Razom research, ammonia concentrations in Lviv water samples were 165 times higher and nitrate concentrations were 50 times higher than the permitted levels (Rawtani *et al*., 2022). Agriculture production has been significantly curtailed as a result of the armed conflict, resulting in worldwide food shortages, with the Middle East and Africa bearing the brunt of the burden (Rawtani *et al.*, 2022) the water ways suffered a lot of environmental cost of war."

The battle and occupation have caused or worsened damage and disruption to a variety of coastal and marine habitats, many of which are fragile or extremely vulnerable making the rare species endangered of being extinct. At least 14 Ramsar sites, which are valuable wetland habitats recognized under the Ramsar Convention on Wetlands, are under threat of destruction. The vast shallow marine lagoons and the largest island in the Black Sea in Karkinitska and Dzharylgatska bays, the Dnipro river delta, a haven for nature in a region known for its vast agricultural fields, and the bogs, meanders, and natural meadows of the Desna river floodplains in the Sumy region are among them.(Cundy, 2022). Wetlands and biosphere reserves in the Sea of Azov, Danube Delta, and Gulf of Odessa have the most vulnerable biodiversity. Water pollution and biodiversity loss have an influence on coastal and marine protected areas. For example, various coastline protected areas in the Azov Sea, Odessa, and the Danube Delta, which are vital habitats for migrating birds, are on the verge of being directly or indirectly impacted by this dispute (Pereira *et al*., 2022). The Cultural and Natural Heritage Convention[13] states in Article 6 (3) that "Each member state of this Convention is committed to refraining from any intentional actions that could directly or indirectly harm the cultural and natural heritage, as outlined in Articles 1 and 2, located within the territory of other Convention member states." Therefore, any destruction of cultural or natural heritage during a war should be seen as a violation of this requirement. The Convention doesn't directly address marine ecosystems, but because they are a component of natural heritage, its principles can be applied to them. The primary goal of the Convention for the Protection of the World Cultural and

[13] https://whc.unesco.org/en/convention/

Natural Heritage is to safeguard important natural and cultural resources around the world. It places a duty on signatories to protect the natural and cultural assets found in other signatory states.

Conclusion

This review article on the effects of the armed conflict on Ukraine's water infrastructure and marine ecosystem reveals a range of long-term ramifications not only for local populations and ecosystems, but also for progress towards the global Sustainable Development Goals. The maritime environment must be safeguarded to mitigate the long-term ecological and human repercussions of war and conflict. It is recommended that national governments and nations worldwide collaborate in order to create "marine safe zones," which forbid military operations that would damage marine life or destabilize delicate aquatic balances, which are comparable to no-fly zones. Additionally, there should be improved monitoring systems that make use of satellite and maritime sensors to swiftly detect and tackle any environmental degradation. Finally, promoting discourse on the environmental effects of military operations can help decision-makers make more informed choices, ensuring that geopolitical goals do not take precedence over the shared responsibility of protecting our planet's marine resources.

In conclusion, this study emphasizes the important environmental consequences of war actions on maritime ecosystems, especially in the Black Sea as demonstrated by the Ukraine-Russia conflict. The study emphasizes the importance of conducting mitigation and restoration activities, enhancing international legal frameworks, and encouraging joint initiatives to protect marine biodiversity during and after armed conflicts.

References

Andreikovets, K. (2022). At least 3,000 dolphins have died in the Black Sea since the start of the war. [online] babel.ua. Available online at: https://babel.ua/en/news/80471-at-least-3-000-dolphins-have-died-in-the-black-sea-since-the-start-of-the-war [Accessed 11 November 2023].

Bakan, G. and Büyükgüngör, H. (2000). The Black Sea. *Marine Pollution Bulletin*, 41(1-6): 24. DOI: https://doi.org/10.1016/S0025-326X(00)00100-4.

Bekiarova, N. (2017). *The Growing Military Activity In The Black Sea Region As A Security Threat*. Strategic Impact, 44-53. Available online at: https://www.ceeol.com/search/article-detail?id=829344 [Accessed 13 November 2023].

Borou, O. (2009). The wider Black Sea region in the 21st century: strategic, economic and energy perspectives. *Southeast European and Black Sea Studies*, 9(3): 383–384. DOI: https://doi.org/10.1080/14683850902934366.

Bouvier, A. (1992). Report submitted to the 47th session of the United Nations General Assembly. International Committee of the Red Cross (ICRC). Available online at: https://www.icrc.org/en/doc/resources/documents/statement/5cjknj.htm [Accessed 27 November 2023].

CEOBS (2023). Ukraine Conflict Environmental Briefing: The Coastal and Marine Environment. Conflict and Environment Observatory and Zoi Environment Network, February, 2023. Available online at: https://ceobs.org/ukraine-conflict-environmental-briefing-the-coastal-and-marine-environment/ [Accessed 2 June 2023].

Cherkez, E.A., Dragomyretska, O.V. and Gorokhovich, Y. (2006). Landslide protection of the historical heritage in Odessa (Ukraine). *Landslides*, 3: 303–309. Available online at: https://doi.org/10.1007/s10346-006-0058-8.

Cundy, A. (2022). Dead dolphins: how nature became another casualty of the Ukraine war. The Guardian [online] 7 June 2022. Available online at: https://www.theguardian.com/environment/2022/jun/07/dead-dolphins-how-nature-became-another-casualty-of-the-ukraine-war [Accessed 11 November 2023].

Fowler, O. (2023). How War in Ukraine Affected the Environment [online]. Impakter. Available at: https://impakter.com/how-war-affects-ukraine-environment/ [Accessed 2 August 2023].

Francis, R.A. (2011). The Impacts of Modern Warfare on Freshwater Ecosystems. *Environmental Management*, 48(5): 985–999. DOI: https://doi.org/10.1007/s00267-011-9746.

Gleick, P.H. (2019). Water as a Weapon and Casualty of Conflict: Freshwater and International Humanitarian Law. *Water Resources Management*, 33: 1737. DOI: https://doi.org/10.1007/s11269-019-02212-z.

Holdgate, M. and Giovannini, B. (1994). Biodiversity conservation: Foundations for the 21st century. Widening Perspectives on Biodiversity, [online] pp.3–5. Available online at: https://scholar.google.com/scholar?cluster=14363503410163164357&hl=en&as_sdt=2005&sciodt=0,5#d=gs_qabs&t=1702304404555&u=%23p%3DxSTjHEBqVccJ [Accessed 11 November 2023].

Holmes, J.R. and Yoshihara, T. (2017). Deterring China in the "Gray Zone": Lessons of the South China Sea for U.S. Alliances', *Orbis*, 61: 322. DOI: https://doi.org/10.1016/j.orbis.2017.05.002.

Hook, K. and Marcantonio, R., 2022. Environmental dimensions of conflict and paralyzed responses: the ongoing case of Ukraine and future implications for urban warfare. *Small Wars & Insurgency*. DOI: https://doi.org/10.1080/09592318.2022.2035098.

ICRC (2008). How Is the Term "Armed Conflict" Defined in International Humanitarian Law? Opinion Paper. Available online at: https://www.icrc.org/en/doc/assets/files/other/opinion-paper-armed-conflict.pdf [Accessed 2 June 2023].

Istanbul, S.U. (2022). Ukraine war may be causing rise in dolphin deaths, say scientists [online]. The Guardian. Available online at: https://www.theguardian.com/environment/2022/may/10/ukraine-war-rise-dolphin-deaths-strandings-black-sea [Accessed 11 November 2023].

Khilchevskyi, V.K. and Mezentsev, K.V. (2021). Water Conflicts and Ukraine: Donbas Region. In 15th International Conference Monitoring of Geological Processes and Ecological Condition of the Environment. DOI: https://doi.org/10.3997/2214-4609.20215K2004.

Kolodezhna, V. and Vasyliuk, O. (2022). Mass dolphin mortality in the Black Sea: a military perspective – Ukraine War Environmental Consequences Work

Group [online]. UWEC Work Group. Available at: https://uwecworkgroup.info/mass-dolphin-mortality-in-the-black-sea-a-military-perspective/ [Accessed 2 June 2023].

Kormych, B. and Malyarenko, T. (2022). From Gray Zone to Conventional Warfare: The Russia-Ukraine Conflict in the Black Sea. *Small Wars & Insurgencies*, 1. DOI: https://doi.org/10.1080/09592318.2022.2122278.

Lishchynskyy, I. (2016). Spatial concentration of industry and local production systems in Ukraine. *Acta Universitatis Lodziensis. Folia Oeconomica*, 2(320). DOI: https://doi.org/10.18778/0208-6018.320.04.

Lieber Institute (2022). Oil Tankers as "Environmental Time Bombs," or Not. Available online at: https://lieber.westpoint.edu/oil-tankers-environmental-time-bombs-or-not/ [Accessed 27 November 2023].

Mason, M. (2022). Infrastructure under Pressure: Water Management and State-Making in Southern Iraq. *Geoforum*, 132: 52. DOI: https://doi.org/10.1016/j.geoforum.2022.04.006.

Olajide, M. (2022). Economic, maritime and ecological implications of military activities in the Black Sea. [online] Businessday NG. Available online at: https://businessday.ng/opinion/article/economic-maritime-and-ecological-implications-of-military-activities-in-the-black-sea/ [Accessed 13 November 2023].

Pereira, P., Bašić, F., Bogunovic, I. and Barcelo, D. (2022). Russian–Ukrainian war impacts the total environment. *Science of the Total Environment*, 837: 155865. DOI: https://doi.org/10.1016/j.scitotenv.2022.155865.

Rawtani, D., Gupta, G., Khatri, N., Rao, P.K. and Hussain, C.M. (2022). Environmental damages due to war in Ukraine: A perspective. *Science of The Total Environment*, 850: 157932. DOI: https://doi.org/10.1016/j.scitotenv.2022.157932.

Renolafitri, H., Yolandika, C. (2022). Impact of the Russia-Ukraine war on the environmental, social and economic conditions of the Black Sea. *Economic Management and Social Sciences Journal*, 1(1): 1–7. DOI: https://doi.org/10.56787/ecomans.v1i1.4.

Schillinger, J., Özerol, G., Güven-Griemert, Ş. and Heldeweg, M. (2020). Water in war: Understanding the impacts of armed conflict on water resources and their management. WIREs Water [online], 7(6). DOI: https://doi.org/10.1002/wat2.1480.

Shevchuk, S., Vyshnevskyi, V. and Bilous, O. (2022). 'The use of remote sensing data that is studying the environmental consequences of Russia–Ukraine War'. *J. Landsc. Ecol.*, 15: 36–53. DOI: https://doi.org/10.21203/rs.3.rs-1770802/v1.

Shumilova, O., Tockner, K., Sukhodolov, A., Khilchevskyi, V., De Meester, L., Stepanenko, S., Trokhymenko, G., Hernández-Agüero, J.A. and Gleick, P. (2023). Impact of the Russia–Ukraine armed conflict on water resources and water infrastructure. *Nature Sustainability*, 6: 1–9. DOI: https://doi.org/10.1038/s41893-023-01068-x.

State Agency of Water Resources of Ukraine (2022). Analytical Review of the Qualitative State of Surface Water Bodies in the Area of the Don River Basin in August 2022. Available online at: https://sdbuvr.gov.ua/news/analitychnyy-ohlyad-yakisnoho-stanu-poverkhnevykh-vodnykh-obyektiv-rayonu-baseynu-richky-don-u [Accessed: 2 August 2023].

Turkish Marine Research Foundation (2022). Press release – a war in the Black Sea and its effects on marine environment. Turkish Marine Research Foundation. Available online at: https://tudav.org/en/from-us/press-releases/press-release-a-war-in-the-black-sea-and-its-effects-on-marine-environment/ [Accessed 1 August 2023].

UN Environment (2017). Black sea. [online] UNEP - UN Environment Programme. Available online at: https://www.unep.org/explore-topics/oceans-seas/what-we-do/working-regional-seas/regional-seas-programmes/black-sea/ [Accessed 10 November 2023].

UNICEF (2022). 1.4 Million People Without Running Water Across War-Affected Eastern Ukraine. UNICEF Ukraine. Available online at: https://www.unicef.org/ukraine/en/press-releases/14-million-people-without-running-water-across-war-affected-eastern-ukraine [Accessed 2 August 2023].

UN-Water Technical Advisory Unit (2016). Water and Sanitation Interlinkages Across the 2030 Agenda for Sustainable Development. Available online at: https://www.unwater.org/publications/water-and-sanitation-interlinkages-across-2030-agenda-sustainable-development [Accessed 11 November 2023].

UWEC Work Group (2023). War and the Sea: How Hostilities Threaten the Coastal and Marine Ecosystems of the Black and Azov Seas. Ukraine War Environmental Consequences Work Group (UWEC Work Group). Available online at: https://uwecworkgroup.info/war-and-the-sea-how-hostilities-threaten-the-coastal-and-marine-ecosystems-of-the-black-and-azov-seas/ [Accessed 11 November 2023].

WWF (2023). Assessing the Environmental Impacts of the War in Ukraine [Online]. World Wide Fund for Nature (WWF) Central and Eastern Europe, Budapest, Hungary. Available online at: https://wwfcee.org/our-offices/ukraine/assessing-the-environmental-impacts-of-the-war-in-ukraine [Accessed 2 August 2023].

Zheleznyak, M., Donchyts, G., Maderich, V., Dronova, I., Tkalich, P., Trybushnyi, D., Faybishenko, B. and Dvorzhak, A. (2022). Ecological footprint of Russia's Ukraine invasion. *Science*, 377(6612): 1273-1273. DOI: https://doi.org/10.1126/science.ade6869.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	Author 1	Author 2	Author 3	Author 4
Conceived and designed the research or analysis	Yes	Yes	Yes	No
Collected the data	Yes	Yes	No	No
Contributed to data analysis & interpretation	Yes	Yes	Yes	Yes
Wrote the article/paper	Yes	Yes	Yes	Yes
Critical revision of the article/paper	No	Yes	No	Yes
Editing of the article/paper	Yes	No	Yes	Yes
Supervision	No	Yes	Yes	Yes
Project Administration	Yes	No	No	No
Funding Acquisition	No	No	No	No
Overall Contribution Proportion (%)	30	25	25	20

Funding
No funding was available for the research conducted for and writing of this paper.

Research involving human bodies or organs or tissues (Helsinki Declaration)
The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not a clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

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(Optional) PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)
The author(s) has/have NOT complied with PRISMA standards. It is not relevant in case of this study or written work.

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